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We Are What We Eat: Personalized Food Recommendation System

Namrata Amane
Department of Computer Science and Engineering Annasaheb Dange College of Engineering and Technology Ashta, India
amanenk10@gmail.com

Prof. Ashvini Patil
Department of Computer Science and Engineering Annasaheb Dange College of Engineering and Technology Ashta, India
asp cse@adcet.in

Mrunal Patil
Department of Computer Science and Engineering Annasaheb Dange College of Engineering and Technology Ashta, India
mrunalp198@gmail.com

Abstract

As today's scenario is concerned about getting the things as early as possible or with less effort, the acquaint of online resources is increasing tremendously and one of the things that the people are putting glance on is the online delivery of food. There are many applications which provide efficient food delivery. We have many choices and little time to explore them all. For being healthy, we should have also nutrition management techniques. Hygienic and cost effectiveness are also considerable aspects to choose the food. In this context, our system is providing a solution for all these aspects. We are gathering data to get customer's interest. In addition, our system is filtering and giving a recommended list with managed nutrition chart. To enhance customer's attraction, the system is also recommending promotions, offers and tips.

Index Terms—*Food recommendation system, Content-based filtering, Collaborative filtering, Prediction matrix.*

I. INTRODUCTION

There are three most basic needs of human being as food, clothes and shelter.Food is the foremost necessity of human being which provides nutrition and energy to survive. For being healthy, exercise, yoga and many more things are needed. But the most basic thing that must be taken into consideration is a healthy diet, which works as essence for improving health conditions.

Most of people are engaged in their daily routines as they are not paying attention towards their health. To be a healthy person, one of the essential things that needs to be followed in daily routine is a good health plan and proper diet. So there should be a system that will actually help people for having a beneficial dietary schedule and also the system should meet the user preferences.

In this proposed work, we are providing a recommended list food items with the consideration of the nutritional value of each food item to users so that they can quickly order their favorite dish and maintain good health. In addition, we are also providing health tips by experts to know more about what they eat.

MOTIVATION

Most of the population is getting affected by many diseases because of having an improper diet schedule and also hav- ing chemical contained food.Our dietary habits directly does impact on our

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health.So the care must be taken for having a healthy lifestyle. But many people are not protective about their health and they are also not knowing the importance of immunity to their health. So there is necessity to design a system that will take care of all the above facts. There are many systems already developed that fulfill all the above aspects, but there is need to develop a system that will also meet the taste of the user i.e. the system will also take of user preferences.

II. LITERATURE SURVEY

A. u-BabSang: a context-aware food recommendation system. [1]

Author of this paper presented a system which provides rec- ommended list for health care applications.They are referring this system as Babsang which provides provides recommended list for each user on the table and also gives healthy tips as complementary . System takes personal information of user and other natural information around the table as an input. To implement this, they proposed collaborative filtering to get recommended list for each user. In this way they are providing user based recommended list for all user on the table

B. Intelligent Food Planning: Personalized Recipe Recommen- dation. [2]

In this paper, they have focused on the two initial facts of food recommendations: data capture and food-recipe re- lationships. They have proposed an initial analysis as to the practicality of collecting food preferences and making recipe recommendations.To meet this high coverage and reasonable accuracy, content based strategies are found to be best in order to relate recipes and food items. This paper includes an investigation into more intelligent means of reasoning on foodratings when recipe ratings are known. The first consideration concerns the impact of mixed ratings on recipes.

C. Smart Kitchen: Recipe Recommendation System. [3]

Author of the paper presented a web based system as it is developed for those who are in a rush.In this proposed work, they have put out work to build a prototype for recommenda- tion of receipe. The system gives recommendation to the user or suggest recipe to the user based on user preference or the ingredients that are currently available.

D. User's Food Preference Extraction Personalized Recom- mendation. [4]

In this research, they have collected all the historical data of each user and made user preference recommended list. They have used user's personal information and their past actions to get user choice. They implemented user based recommended algorithms and provided user's favorite item lists. This system uses use's historical data and their browsing actions to get their recommended lists.

III. BACKGROUND

Machine learning is an application of artificial intelli- gence (AI) that aims to work like human without any hu- man intervention.systems the ability to automatically learn and improve from experience without being explicitly pro- grammed. Machine learning concentrates on the development of computer programs that can access data and use this data to learn for themselves. The learning process invloves data observations,analysis of data, past behaviour of data or any experience,etc in order to put a glance for the patterns that data contain and to reach out to better decisions in the future based on the examples that we provide to the system. The primary aim of machine learning is to make the computers to learn themselves without human intrudance and perform tasks accordingly.

A. Recommendation System

As data is growing rapidly, use of this data is also using for better results. Recommendation system are the systems that takes historical data for customers and other entities and provide a recommended results. Every human on the planets thinks with their perspectives only. Recommended systems are responsible to decide their perspectives and make the human intelligent results by using machines only.

In this context, system uses following filtering algorithms:

- Content-based filtering
- Collaborative filtering

1) Content-based filtering: Content based filtering is also referred as cognitive filtering, which provide recommendation of items based on a comparison between the item contents and profile of the user. The content of each item is represented as a set of descriptors or terms, typically the words that occur in a document. The user profile is represented by the same terms and built up by analyzing the content of items which have been seen by the user. Term Frequency (TF) and Inverse Document

Frequency (IDF) stated as main concepts which are used in content-based filtering mechanisms. These terms are used to determine the document entities importance.TF is defined as the frequency of a word in a document. IDF is defined as the inverse of the document frequency among the whole set of documents.

2) Collaborative Filtering: Collaborative filtering systems make recommendations based on the history of users' pref- erences given for items. We are using this mechanism in our system. Collaborative filtering systems can be also referred as item-based collaborative filtering. The preference given by the user can be presented as a user-item matrix.The applications collaborative filtering involve large data sets also collaborative filtering methods have been applied to different kinds of data. We are using this filtering mechanism to recommend a list of food items to the user, based on their previous rating history. In addition, we are having nutrition chart for each food item. After getting good result from collaborative filtering, we are recommending food list with respect to nutritional value.

IV. SYSTEM DESIGN

System Design describes the architecture of the proposed system (see Figure 5.1). There are three modules of the system such as data collection, data processing and final results. Phase one deals with the collection of data from user side, followed by second phase, which deals with the data processing phase where combinations are formed by recommended system.The final results are displayed in the form of whole recommenda- tion list along with the nutrition chart.

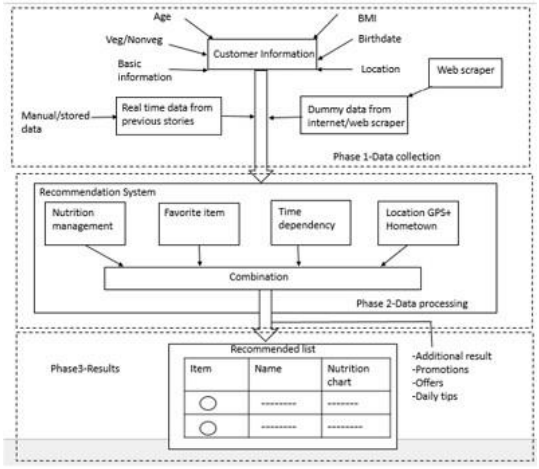

Fig. 1. System Design

A. Data Collection

This phase contains retrieval of users basic information along with some parameters such as BMI (Body Mass Index), location, veg/non veg, basic information (Name, Email, Con- tact number), real time data from previous orders and dummy data from the internet. This information is required as input for

further processing by the system, i.e. to form combinations of all possible outcomes

Real time data - In the process of data collection real time data refer to all user information mentioned above. It also includes lists of previously ordered recipes by the user which elaborates user's interest. Dummy data - Conceptually dummy data can be used as a placeholder for both testing and operational purpose. In concern with our system dummy data includes nutrition chart for recipes i.e. nutrition values of various ingredients from web scrapers.

B. Data Processing

In this phase system will form combinations, for recommen-

	Aloo-Tikki	Chicken	Paneer
Alis	L	L	D
Babu	?	L	L
Chris	L	L	D
John	L	D	?

TABLE I
USER AND ITEM EXAMPLE

Similarly, similarities between Aloo-Tikki and Paneer is 0, so we can say that John dislikes Paneer.

In short, we can have a simple prediction formula with respect to items as follows

dation, based on data collected as a result of the first phase. For that it requires database access stored during the first phase.For

$$P(u,j)=\gamma \sum_{i=1}^{n} w(i,j)r$$

of ui

forming these combinations following parameters are taken under considerations.

1) Nutrition management: It includes the nutritional values of all included dishes along with their specific information like category under which they belong and specialty of that dish. The nutritional value is calculated by taking ratio of proteins, carbohydrates, vitamins and fats.Additionally, it also provides calorie information.

2) Favourite items list: - This includes targeted results. We are providing recommended list to the user. So that they can quickly order their favorite dish and get balanced with healthy dietary tips.

3) Diet Schedule: - We are suggesting diet schedule to each user and probably we can alert them so that they can't miss their dishes. Taking food with perfect timings is also good practice for being healthy.

4) Location based recommendations: This includes recom- mendations based on location of the user from which user will get famous food items in that area. We can also know more about user's choice with this field.

5) Medical history (Allergic concern): This will help to avoid dishes which contain allergic ingredients mentioned by user.

C. Results

Based on combinations formed in the second phase, system will introduce recommendation list of user which contains food items and nutrition chart for that particular item. The system will also display

following concerns:

- Daily tips regarding dietary habits
- Promotions and offers provided by company

V. IMPLEMENTATION

Item based Collaborative System is an algorithm from column perspective. Matrix shown in Table 6.1 is an example of an item based collaborative system. In the table, ”L” is for like and ”D” is for dislike. This filtering is used when you know that user has rated many items. You can see that the ratings of Aloo-Tikki and chicken are same.So the similarity between Aloo-Tikki and chicken is one. So Bob dislikes chicken that basically means Bob also dislikes Aloo-Tikki.

This formula states that P(u,j) has weighted mean of the rating that user u has given to other similar food items where γ is normalization factor. Traverse over all m items rated by user and measure their rating averaged by their similarities to the predicted items while w(i,j) is a measure of similarity.

In our system, we are using the same mechanism to get recommended food list. For demonstration, we are taking data of 1000 users and 100 items. Each user has provided their rating from 1 to 5. Following are the steps to produce recommendation in python(assuming that we have already installed required packages)

- Reading Data from Datasets.
- Mapping Data into Matrix
- Finding Similar Matrix.
- Finding Prediction Matrix

A. Reading Data from Datasets

The figure contains user-items data and their ratings. This is raw data having 4 columns as user-id, item-id, ratings and unix-timestamp. This data should be sorted to get good results. We sorted this data using the python function. Currently we are retrieving data from excel files using python package called pandas.

B. Mapping Data into Matrix

To process mathematical function, we are using a list data structure to represent data in matrix form. We are taking empty lists with respect to total number of user-ids and item-ids. In this case, rows represent user and columns represent items. The values in the matrix are the ratings on each item given by each user. So we are processing each user-item data to get recommended item list.

C. Finding Similar Matrix

If one user has given a good rating of a particular item, this means that the user likes that item. Moreover, if more users are given good ratings for one item, this item has a good similarity score and it is recommended. To get this information and map into our matrix, we are using following python code to get their pairwise distance. Figure 6.2 shows that similarity matrix.

- us = pairwise distances(dm, matrix=’cosine’) _
- is = pairwise distances(dm.T, matrix=’cosine’) _

	user_id	dish_id	rating	unix_timestamp
0	244	51	2	880606923
1	6	86	3	883603013
2	210	40	3	891035994
3	224	29	3	888104457
4	308	1	4	887736532
5	38	95	5	892430094
6	301	98	4	882075827
7	290	88	4	880731963
8	7	32	4	891350932
9	10	16	4	877888877
10	99	4	5	886519097
11	115	20	3	881171009
12	138	26	5	879024232
13	243	15	3	879987440
14	293	5	3	888906576
15	276	54	3	874791025

Fig. 2. Raw data-set

```
[[0.         0.59761782 0.66975521 ... 0.48777191 0.42570738 0.52430326]
 [0.59761782 0.         0.72693082 ... 0.579079   0.579658   0.59942759]
 [0.66975521 0.72693082 0.         ... 0.71780393 0.72163499 0.75219803]
 ...
 [0.48777191 0.579079   0.71780393 ... 0.         0.37682896 0.46718999]
 [0.42570738 0.579658   0.72163499 ... 0.37682896 0.         0.48805584]
 [0.52430326 0.59942759 0.75219803 ... 0.46718999 0.48805584 0.        ]]
```

Fig. 3. Similarity Matrix

D. Finding Prediction Matrix

According to our formula explained at the start of this section, following code is used to get that prediction matrix. This predicts that the user likes food items having good user-item value. Figure 4 shows a final prediction matrix. Finally user with more item score in the matrix is the most recommended food items for that user. In this way we can get recommended food list for all users.

```
[[ 3.73755897  3.68110001  3.67756813 ...  3.70091139  3.72854642
   3.6889199 ]
 [ 0.31620267  0.25728517  0.24732651 ...  0.28680422  0.32578284
   0.26841999]
 [ 0.08418047 -0.00849839 -0.01871879 ...  0.02981073  0.07861835
   0.00665839]
 ...
 [ 0.08418047 -0.00849839 -0.01871879 ...  0.02981073  0.07861835
   0.00665839]
 [ 0.08418047 -0.00849839 -0.01871879 ...  0.02981073  0.07861835
   0.00665839]
 [ 0.08418047 -0.00849839 -0.01871879 ...  0.02981073  0.07861835
   0.00665839]]
```

Fig. 4. Prediction Matrix

VI. CONCLUSION

The facilities provided by the system are very useful for users to get the food items of their choice.Item based collab- orative filtering approach is implemented to meet the above fact.We integrated similarities of the user's choice of different food items and made a prediction matrix which shows most recommended food item list for that user.In addition we are providing health tips and nutrition chart to each user to get balanced diet and meet health goals.

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